# 13.1 EXERCISES

HOMEWORK KEY

○ = WORKED-OUT SOLUTIONS on p. WS1 for Exs. 5, 11, and 33

★ = STANDARDIZED TEST PRACTICE Exs. 2, 15, 20, 33, and 36

◆ = MULTIPLE REPRESENTATIONS Ex. 34

## 4 PRACTICE AND APPLY

### Assignment Guide

**Answer Transparencies available for all exercises**

**Basic:**
Day 1: SRH p. 995 Exs. 5–8
pp. 856–858
Exs. 1–11, 15–23, 30–34, 38–54 even

**Average:**
Day 1: pp. 856–858
Exs. 1, 2, 4–6, 10–12, 15–20, 23–28, 30–36, 39–55 odd

**Advanced:**
Day 1: pp. 856–858
Exs. 1, 2, 7, 8, 15–20, 24–29*, 32–37*, 39, 43, 47, 48, 51, 53

**Block:**
pp. 856–858
Exs. 1, 2, 4–6, 10–12, 15–20, 23–28, 30–36, 39–55 odd (with 13.2)

### Differentiated Instruction

See *Algebra 2 Best Practices Toolkit* for suggestions on addressing the needs of a diverse classroom.

### Homework Check

For a quick check of student understanding of key concepts, go over the following exercises:

**Basic:** 4, 10, 17, 22, 32

**Average:** 6, 12, 18, 24, 34

**Advanced:** 8, 14, 19, 26, 35

### Extra Practice

- Student Edition, p. 1022
- Chapter 13 Resource Book: Practice levels A, B, C, pp. 6–8

**Practice Worksheet**

An easily-readable reduced practice page (with answers) for this lesson can be found on p. 850C.

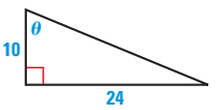
## SKILL PRACTICE

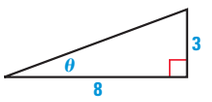
**A**

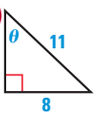
1. **VOCABULARY** What is an angle of elevation? The angle formed by the line of sight to an object and a line parallel to the ground.
2. ★ **WRITING** *Explain* what it means to solve a right triangle. Find any missing information so the measures of all 3 angles and sides are known.

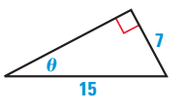
**EXAMPLE 1** on p. 852 for Exs. 3–8

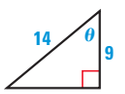
**EVALUATING FUNCTIONS** **Evaluate the six trigonometric functions of the angle $\theta$.** 3–8. See margin.

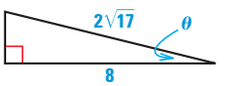
3. 


4. 


5. 


6. 


7. 


8. 


**EXAMPLE 2** on p. 853 for Exs. 9–16

**FINDING VALUES** **Let $\theta$ be an acute angle of a right triangle. Find the values of the other five trigonometric functions of $\theta$.** 9–14. See margin.

9. $\sin\theta = \frac{5}{6}$
10. $\cos\theta = \frac{5}{8}$
11. $\tan\theta = \frac{7}{3}$
12. $\csc\theta = \frac{10}{7}$
13. $\sec\theta = \frac{12}{5}$
14. $\cot\theta = \frac{6}{11}$

15. ★ **MULTIPLE CHOICE** In a right triangle, $\theta$ is an acute angle and $\cos\theta = \frac{4}{9}$. What is the value of $\tan\theta$? C

(A) $\frac{4\sqrt{65}}{65}$ (B) $\frac{\sqrt{65}}{9}$ (C) $\frac{\sqrt{65}}{4}$ (D) $\frac{9}{4}$

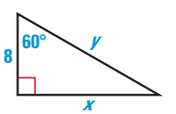
16. **ERROR ANALYSIS** *Describe* and correct the error in finding $\csc\theta$, given that $\theta$ is an acute angle of a right triangle and $\cos\theta = \frac{7}{11}$.

$\csc\theta = \frac{1}{\cos\theta} = \frac{11}{7}$ ✗

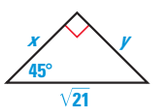
16. Cosecant is not the reciprocal of cosine, it is the reciprocal of sine; $\sin\theta = \frac{6\sqrt{2}}{11}$, $\csc\theta = \frac{1}{\sin\theta} = \frac{11}{6\sqrt{2}} = \frac{11\sqrt{2}}{12}$.

**EXAMPLE 3** **B** on p. 854 for Exs. 17–20

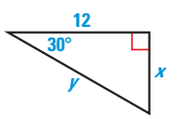
**FINDING SIDE LENGTHS** **Find the exact values of $x$ and $y$.**

17. 

$x = 8\sqrt{3}$, $y = 16$

18. 

$x = \frac{\sqrt{42}}{2}$, $y = \frac{\sqrt{42}}{2}$

19. 

$x = 4\sqrt{3}$, $y = 8\sqrt{3}$

20. ★ **MULTIPLE CHOICE** In a 30°-60°-90° triangle, the longer leg has a length of 5. What is the length of the shorter leg? A

(A) $\frac{5\sqrt{3}}{3}$ (B) $\frac{5\sqrt{3}}{2}$ (C) $\frac{10\sqrt{3}}{3}$ (D) $5\sqrt{3}$



3–8. See Additional Answers beginning on p. AA1.

9. $\cos\theta = \frac{\sqrt{11}}{6}$, $\tan\theta = \frac{5\sqrt{11}}{11}$, $\csc\theta = \frac{6}{5}$, $\sec\theta = \frac{6\sqrt{11}}{11}$, $\cot\theta = \frac{\sqrt{11}}{5}$

10. $\sin\theta = \frac{\sqrt{39}}{8}$, $\tan\theta = \frac{\sqrt{39}}{5}$, $\csc\theta = \frac{8\sqrt{39}}{39}$, $\sec\theta = \frac{8}{5}$, $\cot\theta = \frac{5\sqrt{39}}{39}$

11. $\sin\theta = \frac{7\sqrt{58}}{58}$, $\cos\theta = \frac{3\sqrt{58}}{58}$, $\csc\theta = \frac{\sqrt{58}}{7}$, $\sec\theta = \frac{\sqrt{58}}{3}$, $\cot\theta = \frac{3}{7}$

**EXAMPLE 4** on p. 854 for Exs. 21–28

**SOLVING TRIANGLES** **Solve $\triangle ABC$ using the diagram and the given measurements.**

**21.** $A = 35°, c = 16$
$B = 55°, a \approx 9.18, b \approx 13.11$

**22.** $B = 53°, a = 12$
$A = 37°, b \approx 15.92, c \approx 19.94$

**23.** $B = 18°, c = 24$
$A = 72°, a \approx 22.83, b \approx 7.42$

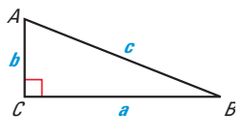
**24.** $A = 67°, b = 7$
$B = 23°, a \approx 16.49, c \approx 17.92$

**25.** $B = 75°, a = 15$
$A = 15°, b \approx 55.98, c \approx 57.96$

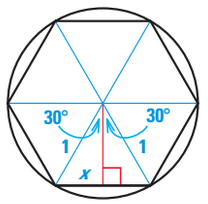
**26.** $A = 49°, c = 27$
$B = 41°, a \approx 20.38, b \approx 17.71$

**27.** $A = 64°, b = 32$
$B = 26°, a \approx 65.61, c \approx 73.0$

**28.** $B = 24°, c = 10.8$
$A = 66°, a \approx 9.87, b \approx 4.39$




C **29. CHALLENGE** A procedure for approximating $\pi$ based on the work of Archimedes is to inscribe a regular hexagon in a circle.




**a.** Use the diagram at the right to solve for $x$. What is the perimeter of the hexagon? $\frac{1}{2}$, 6 units

**b.** Show that a regular $n$-sided polygon inscribed in a circle of radius 1 has a perimeter of $2n \cdot \sin\left(\frac{180}{n}\right)°$. See margin.

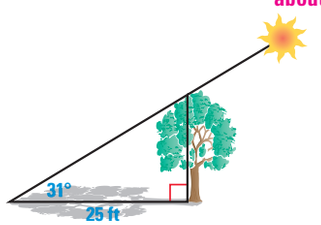
**c.** Use the result from part (b) to find an expression in terms of $n$ that approximates $\pi$. Then evaluate the expression when $n = 50$. $n \sin\left(\frac{180}{n}\right)°$; about 3.14

## PROBLEM SOLVING

**EXAMPLES 5 and 6** on p. 855 for Exs. 30–35

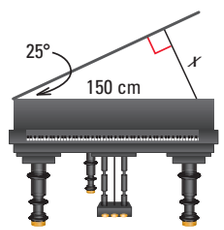
A **In Exercises 30 and 31, use the information in the diagram to solve the problem.**

**30. TREE HEIGHT** A tree casts the shadow shown. What is the height of the tree? about 15 ft




@HomeTutor for problem solving help at classzone.com

**31. GRAND PIANO** Find the length of the prop holding open the piano. about 63.4 cm




**32. RAILWAY** The Falls Incline Railway at Niagara Falls has an angle of elevation of 36°. The railway extends a horizontal distance of about 138 feet. Find the height and length of the railway. height: about 100 ft, length: about 171 ft

**33.** ★ **SHORT RESPONSE** A submersible traveling at a depth of 250 feet dives at an angle of 15° with respect to a line parallel to the water's surface. It travels a horizontal distance of 1500 feet during the dive. What is the depth of the submersible after the dive? *Explain* how the angle of the dive affects the final depth. About 652 ft. *Sample answer:* The larger the angle the deeper the final depth.

B **34.** **MULTIPLE REPRESENTATIONS** You are climbing Mount Massive in Colorado. You are at an altitude of 11,200 feet. You measure the angle of elevation to a ridge above you to be 29.4°. The distance (along the face of the mountain) between you and the ridge is 6315 feet.

**a. Drawing a Diagram** Draw a diagram that represents this situation. See margin.

**b. Writing an Equation** Write and solve an equation to find the altitude of the ridge. $\sin 40.5° = \frac{h - 7500}{10{,}653}$, $h \approx 14{,}419$ ft



## Study Strategy

**Exercises 17 and 19** Students often have trouble remembering the exact values of the trigonometric functions of 30° and 60° angles, so it is helpful to show them a way to figure these out for themselves. Tell them to write in their notebooks and remember, "The side opposite the 30° angle is half the hypotenuse." From that, the length of the side opposite the 60° angle can be calculated by the Pythagorean theorem, and then the values of all six functions of both of these angles follow.

## Teaching Strategy

**Exercises 17–19** Show students how an equilateral triangle can be cut in half to form two 30°-60°-90° triangles, which will illustrate *why* the side opposite the 30° angle is half as long as the hypotenuse. Also show how it is easy to find the values of the six trigonometric functions of a 45° angle by applying the definition of an isosceles triangle and the Pythagorean theorem. This approach will give students tools for figuring out the values of the trigonometric functions of the special angles on their own rather than depending on memorization.

## Avoiding Common Errors

**Exercises 21–28** Some students make errors in solving right triangles because they incorrectly identify the sides that are adjacent and opposite a certain angle, especially if the triangle is oriented differently from the figure on the top of page 852. Guide these students to first locate the acute angle whose measure is given and then go across from its vertex to find the opposite side for *that* angle.

## Internet Reference

**Exercise 32** More information about the Falls Incline Railway can be found at www.niagaraparks.com/nfgg/firailway.php

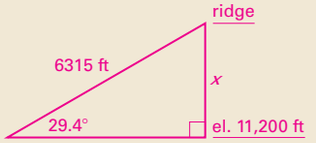
**12.** $\sin\theta = \frac{7}{10}$, $\cos\theta = \frac{\sqrt{51}}{10}$, $\tan\theta = \frac{7\sqrt{51}}{51}$, $\sec\theta = \frac{10\sqrt{51}}{51}$, $\cot\theta = \frac{\sqrt{51}}{7}$

**13.** $\sin\theta = \frac{\sqrt{119}}{12}$, $\cos\theta = \frac{5}{12}$, $\tan\theta = \frac{\sqrt{119}}{5}$, $\csc\theta = \frac{12\sqrt{119}}{119}$, $\cot\theta = \frac{5\sqrt{119}}{119}$

**14.** $\sin\theta = \frac{11\sqrt{157}}{157}$, $\cos\theta = \frac{6\sqrt{157}}{157}$, $\tan\theta = \frac{11}{6}$, $\csc\theta = \frac{\sqrt{157}}{11}$, $\sec\theta = \frac{\sqrt{157}}{6}$

29b. See Additional Answers beginning on p. AA1.

34a.

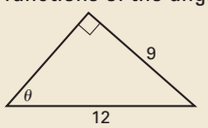


## 5 ASSESS AND RETEACH

### Daily Homework Quiz

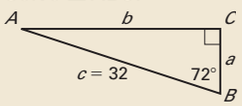
**Transparency Available**

**1.** Evaluate the six trigonometric functions of the angle $\theta$.




$\sin\theta = \frac{3}{4}$, $\cos\theta = \frac{\sqrt{7}}{4}$, $\tan\theta = \frac{3\sqrt{7}}{7}$, $\csc\theta = \frac{4}{3}$, $\sec\theta = \frac{4\sqrt{7}}{7}$, $\cot\theta = \frac{\sqrt{7}}{3}$

**2.** Solve $\triangle ABC$.




$A = 18°$, $a \approx 9.89$, $b \approx 30.4$

**3.** From a point on the ground 64 feet from the base of a tree, the angle of elevation to the top of the tree is 28°. Estimate the height of the tree. **about 34 ft**

**Online Quiz**

Available at **classzone.com**

### Diagnosis/Remediation

- Practice A, B, C in Chapter 13 Resource Book, pp. 6–8
- Study Guide in Chapter 13 Resource Book, pp. 9–10
- Practice Workbook, pp. 181–182
- @HomeTutor

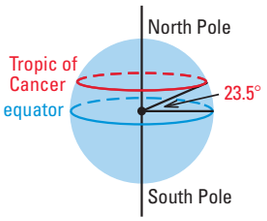
### Challenge

Additional challenge is available in the Chapter 13 Resource Book, p. 13.

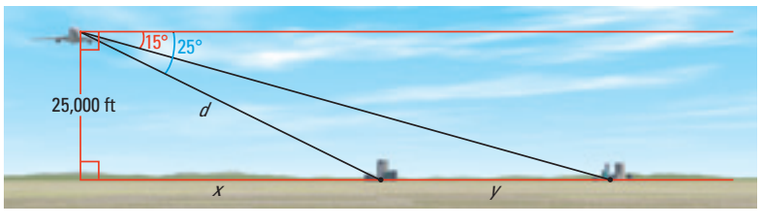
**35. TROPIC OF CANCER** The Tropic of Cancer is the circle of latitude farthest north of the equator where the sun can appear directly overhead. It lies 23.5° north of the equator, as shown.

**a.** Find the circumference of the Tropic of Cancer using 3960 miles as Earth's approximate radius. **about 22,818 mi**

**b.** What is the distance between two points on the Tropic of Cancer that lie directly across from each other? **about 7263 mi**




**36. ★ EXTENDED RESPONSE** A passenger in an airplane sees two towns directly to the left of the plane.




**a.** What is the distance $d$ from the airplane to the first town? **about 59,155 ft**

**b.** What is the horizontal distance $x$ from the airplane to the first town? **about 53,613 ft**

**c.** What is the distance $y$ between the two towns? *Explain* the process you used to find your answer. **See margin.**

36c. About 39,688 ft; first find the horizontal distance, $x + y$, between the airplane and the second town to be about 93,301 feet. Then subtract 53,613 feet to find the distance between the two towns.

C **37. CHALLENGE** You measure the angle of elevation from the ground to the top of a building as 32°. When you move 50 meters closer to the building, the angle of elevation is 53°. How high is the building? **about 59 m**

## MIXED REVIEW

**PREVIEW** Prepare for Lesson 13.2 in Exs. 38–43.

**Perform the indicated conversion.** *(p. 2)*

**38.** 3 years to seconds **94,608,000 sec**

**39.** 10 pints to gallons **$1\frac{1}{4}$ gal**

**40.** 500 feet to yards **$166\frac{2}{3}$ yd**

**41.** 9.4 kilograms to grams **9400 g**

**42.** 2 tons to ounces **64,000 oz**

**43.** 5.6 meters to millimeters **5600 mm**

**Solve the system using any algebraic method.** *(p. 160)*

**44.** $2x - y = 8$, $3x + 4y = 23$ **(5, 2)**

**45.** $4x + 3y = -1$, $3x + y = 3$ **(2, −3)**

**46.** $9x - 12y = 20$, $-6x + 8y = 11$ **no solution**

**47.** $12x + 5y = 4$, $3x - 10y = -8$ $\left(0, \frac{4}{5}\right)$

**48.** $-2x + 7y = 16$, $3x - 5y = -2$ **(6, 4)**

**49.** $4x - 6y = 18$, $-2x + y = -3$ **(0, −3)**

**Classify the conic section and write its equation in standard form.** *(p. 650)* **50–55. See margin.**

**50.** $x^2 + y^2 + 4x + 6y - 17 = 0$

**51.** $x^2 - 4y^2 + 6x + 16y + 137 = 0$

**52.** $y^2 - 4y + 16x + 116 = 0$

**53.** $9x^2 + 25y^2 + 162x + 250y + 454 = 0$

**54.** $x^2 + 8x + 4y + 28 = 0$

**55.** $x^2 - y^2 + 14x + 16y - 5 = 0$



**EXTRA PRACTICE** for Lesson 13.1, p. 1022 **ONLINE QUIZ** at classzone.com

**50.** circle; $(x+2)^2 + (y+3)^2 = 30$

**51.** hyperbola; $\frac{(y-2)^2}{36} - \frac{(x+3)^2}{144} = 1$

**52.** parabola; $(y-2)^2 = -16(x+7)$

**53.** ellipse; $\frac{(x+9)^2}{100} + \frac{(y+5)^2}{36} = 1$

**54.** parabola; $(x+4)^2 = -4(y+3)$

**55.** hyperbola; $\frac{(y-8)^2}{10} - \frac{(x+7)^2}{10} = 1$